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Evaluating the quality and reliability of YouTube videos on post–CABG rehabilitation: highlighting the need for clinician-led educational materials

Eurasian Clinical and Analytical Medicine Original Research

YouTube videos on post-CABG rehabilitation

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Abstract

Aim: The purpose of this study is to assess the quality, credibility, and educational appropriateness of YouTube videos that provide information on postoperative care and rehabilitation after Coronary Artery Bypass Graft (CABG) surgery.

Materials and Methods: YouTube was searched using the terms "CABG rehabilitation," "CABG physiotherapy," "CABG recovery exercises," and "post-bypass exercises." Fifty videos that met the inclusion criteria were selected for analysis. To accomplish this, the videos were evaluated using four established assessment tools. The DISCERN instrument and the Global Quality Scale (GQS) were applied to examine the accuracy, reliability, and educational quality of the content. The JAMA Benchmark Criteria were used to assess the transparency and credibility of the information.

Results: The 50 videos reviewed had a mean DISCERN score of 36.8 ± 9.4 and a mean GQS score of 2.3 ± 0.9 and a mean JAMA Benchmark score of 1.2 ± 0.8, indicating overall low to moderate quality, credibility, and transparency. Videos created by healthcare professionals showed significantly higher DISCERN (49.1 ± 8.0), GQS (3.7 ± 0.7), and JAMA (2.3 ± 0.9) scores compared to other sources ($p < 0.001$). No significant relationship was found between video quality and the number of views ($p > 0.05$).

Discussion: Most CABG rehabilitation videos on YouTube fall within the low to moderate quality range. Therefore, there is a clear need for more scientifically robust and professionally produced content on this platform.

Keywords

coronary artery bypass graft, YouTube, DISCERN, global quality scale, JAMA benchmark criteria

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Introduction

Coronary Artery Bypass Graft (CABG) surgery continues to be a widely utilized and effective intervention for individuals with advanced coronary artery disease. Postoperative cardiac rehabilitation plays a vital role in enhancing recovery, improving functional capacity, lowering postoperative complications, and supporting overall quality of life [1,2]. Standard rehabilitation programs typically incorporate aerobic exercise, respiratory training, mobility strategies, and structured patient education, all of which contribute significantly to restoring cardiopulmonary function following surgery [3].

With the increasing use of digital platforms, many patients now seek health information online. Among these platforms, YouTube has emerged as a particularly popular source, largely due to its accessibility, visual learning environment, and widespread user base [4]. Despite these advantages, the medical content available on YouTube can vary dramatically in accuracy and educational quality, as videos may be uploaded by individuals with diverse expertise and without formal content oversight [5]. Such variability can lead to misinformation, which may influence patient behavior, expectations, and safety—an issue of particular concern in clinical areas that require structured and closely monitored rehabilitation, such as post-CABG recovery.

To mitigate these concerns, validated evaluation tools—including the DISCERN instrument and the Global Quality Scale (GQS)—are commonly applied to assess the reliability, thoroughness, and educational usefulness of online health resources [6,7,8]. These instruments enable objective assessment of patient-oriented educational materials across web-based platforms.

The JAMA Benchmark Criteria, developed by the Journal of the American Medical Association, offer a structured approach for judging the accuracy, transparency, and trustworthiness of health information available on digital platforms. With online resources playing a growing role in patient awareness and medical decision-making, evaluating their quality has become increasingly important. Today, the JAMA criteria are commonly used in studies reviewing websites, social media posts, and patient education materials because they provide a clear and effective method for assessing informational integrity [9].

As patients increasingly rely on online resources for postoperative guidance, evaluating the quality of YouTube videos presenting CABG rehabilitation information has become crucial. Therefore, the aim of this study is to systematically assess these videos using the DISCERN, GQS, and JAMA Benchmark Criteria tools to identify current strengths, limitations, and areas in need of improvement within available online educational content.

Materials and Methods

A comprehensive search was carried out on YouTube to locate videos addressing postoperative rehabilitation after CABG surgery. To avoid bias from individualized recommendations and to maintain consistency across results, all searches were conducted in incognito mode. The search was completed on a single day and utilized the following predetermined keywords: "CABG rehabilitation," "CABG physiotherapy," "CABG recovery exercises," "bypass rehabilitation," and "post-bypass exercises". For each term, the first 50 videos displayed by YouTube's relevance-based ranking system were reviewed. Duplicate videos identified across different search terms, and those that failed to meet the predefined eligibility criteria were excluded. Following this screening process, 50 videos met all requirements and were included in the final dataset for analysis. This study analyzed publicly accessible online content and did not involve human participants, patient data, or identifiable personal information. Therefore, in accordance with international ethical guidelines for research on open-access digital materials, ethical committee approval was not required.

Videos were included in the study if they fulfilled specific eligibility requirements. To be considered appropriate for analysis, a video had to contain content directly related to postoperative rehabilitation or exercise following CABG surgery, be publicly accessible without viewing restrictions, and have a minimum duration of at least one minute. Additionally, eligible videos were required to provide educational material such as exercise demonstrations, physiotherapy guidance, or postoperative care instructions, and they had to be published in either English or Turkish. For all videos that met the inclusion criteria, data extraction was performed using a standardized collection form. The following characteristics were recorded: video title, the identity of the uploader, the date of upload, video duration in minutes, total number of views, number of likes, and the uploader category, which was classified as healthcare professional, hospital or clinic, commercial creator, or patient/layperson. All videos were evaluated independently by two reviewers, and any discrepancies between assessments were resolved through discussion and consensus. Videos that failed to meet these standards were excluded. Specifically, videos were removed from the dataset if they appeared more than once across different keyword searches, consisted solely of intraoperative or surgical footage, or primarily served as commercial advertisements or product promotions [8,9].

The Global Quality Scale (GQS) was used to rate the overall educational value, coherence, and usefulness of each video on a 5-point Likert scale, with a score of 1 representing poor quality and 5 indicating excellent, comprehensive educational content [8-10]. To assess the quality and reliability of the selected videos, two validated instruments were utilized. The DISCERN Scale—a 16-item tool designed to evaluate the trustworthiness and quality of information regarding treatment options—was applied, with possible scores ranging from 16 to 80, where higher scores indicate greater quality [12].

The JAMA framework examines four key elements—who created the content (authorship), the sources used (attribution), potential conflicts of interest (disclosure), and how current the information is (currency). Through the assessment of these components, clinicians and researchers can determine whether a resource meets accepted standards for reliable health communication [10,11,13].

Statistical analyses were carried out using non-parametric methods due to the non-normal distribution of the dataset. The Mann–Whitney U test was used to compare differences between two independent groups, while the Kruskal–Wallis test was employed for comparisons across multiple uploader categories. The Spearman correlation coefficient was calculated to determine the relationship between video characteristics—such as view count, number of likes, and video duration—and the DISCERN and GQS scores. All numerical data were expressed as mean ± standard deviation, and statistical significance was defined as $p < 0.05$.

Ethical Approval

This study did not require ethical approval according to the relevant guidelines.

Results

A total of 50 YouTube videos were analyzed. Overall videos (n:50) consisted of healthcare professional videos (n:24) and other sources (n:26). The mean DISCERN score was 36.8 ± 9.4, the mean Global Quality Scale (GQS) score was 2.3 ± 0.9, and the mean JAMA Benchmark score was 1.2 ± 0.8, indicating that the overall quality, credibility, and transparency of the videos were low to moderate. Videos produced by healthcare professionals demonstrated significantly higher DISCERN (49.1 ± 8.0), GQS (3.7 ± 0.7), and JAMA (2.3 ± 0.9) scores compared with

Table 1. Summary of quality scores for CABG rehabilitation videos

Quality Measure	Overall Videos (n = 50)	Healthcare Professional Videos (n=24)	Other Sources Other Sources (n=26)	p value
DISCERN (Mean ± SD)	36.8 ± 9.4	49.1 ± 8.0	30.2 ± 6.7	< 0.001
GQS (Mean ± SD)	2.3 ± 0.9	3.7 ± 0.7	1.8 ± 0.6	< 0.001
JAMA Benchmark Score (0–4)	1.2 ± 0.8	2.3 ± 0.9	0.7 ± 0.5	< 0.001
Correlation With Number of Views	No significant correlation	–	–	> 0.05

videos from non-professional sources ($p < 0.001$). No significant relationship was observed between video quality scores and the number of views ($p > 0.05$) (Table 1).

Discussion

This study evaluated the reliability, educational quality, and transparency of YouTube videos related to postoperative rehabilitation following CABG surgery. Overall, the findings indicate that the majority of available videos fall within a low to moderate quality range based on DISCERN, GQS, and JAMA Benchmark criteria. These results suggest that online content about CABG rehabilitation lacks the level of accuracy, structure, and credibility required for patient education.

Consistent with previous research examining cardiac rehabilitation content on digital platforms, videos produced by healthcare professionals demonstrated significantly higher quality and reliability scores compared with videos uploaded by non-professional sources. This aligns with earlier studies showing that professionally generated content tends to adhere more closely to evidence-based recommendations and includes clearer educational messaging [14,15]. The higher JAMA Benchmark scores among professional videos also reflect better transparency, including clearer authorship, updated information, and appropriate citation of sources.

Another important observation is the absence of a meaningful association between video quality and the number of views. This finding is in line with prior work highlighting that video popularity does not necessarily correlate with educational accuracy or clinical reliability [16]. Therefore, patients may be exposed to widely viewed but low-quality content, which can lead to misconceptions about postoperative recovery and rehabilitation [17].

Given the critical role of structured physiotherapy and supervised rehabilitation in improving outcomes after CABG, the lack of high-quality online resources is concerning. Enhancing the availability of evidence-based, professionally produced educational videos could support patient engagement, improve adherence to rehabilitation programs, and potentially reduce postoperative complications. Professional societies, physiotherapists, and cardiology organizations may consider developing standardized audiovisual materials tailored for patient education.

Limitations

Several limitations of this study should be acknowledged. The evaluation was restricted to YouTube as the sole platform, which limits the applicability of the findings to other digital or social media sources that may also provide information on post-CABG rehabilitation. In addition, the analysis included only a selected set of videos identified through predefined search terms, which may not capture the full scope of available content on the platform. Although validated instruments such as DISCERN, GQS, and the JAMA Benchmark Criteria were used, the assessment process inherently involves a subjective component. Furthermore, as online video content is constantly evolving, the results represent a snapshot in time and may not be reproducible at a later date. Lastly, the study did not evaluate user understanding, patient engagement, or the direct effects of video content on clinical outcomes, which should be explored in future investigations.

Conclusion

The results indicate that most YouTube videos addressing post-CABG rehabilitation provide information of low to moderate quality with respect to reliability, educational content, and transparency. While videos created by healthcare professionals achieved significantly higher scores for quality and credibility than those from non-professional sources, the overall level of available content remains insufficient. Moreover, the absence of a meaningful relationship between video quality and view count suggests that viewer popularity does not correspond to informational accuracy or clinical relevance. Collectively, these findings reveal a substantial deficiency in evidence-based educational resources on YouTube and emphasize the importance of increased clinician engagement in producing accurate, trustworthy, and patient-focused digital materials to enhance post-CABG rehabilitation and patient education. In summary, this analysis demonstrates that although YouTube serves as a widely accessed educational resource, much of the content related to CABG rehabilitation is suboptimal in terms of reliability and credibility. Higher-quality resources produced by healthcare professionals outperform other sources, reinforcing the importance of expert-led digital education in cardiac rehabilitation.

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Scientific Responsibility Statement
The authors declare that they are responsible for the article's scientific content, including study design, data collection, analysis and interpretation, writing, and some of the main line, or all of the preparation and scientific review of the contents, and approval of the final version of the article.

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No animal or human studies were carried out by the authors for this article.

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The authors declare that there is no conflict of interest.

Anxiety levels and factors associated with pain during arteriovenous fistula cannulation in hemodialysis patients

Eurasian Clinical and Analytical Medicine Original Research

Pain and anxiety during fistula canulation

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This study was presented as an oral presentation at the 21st National Congress of Internal Diseases, Antalya, Turkey, 2019

Abstract

Aim: Patients undergoing hemodialysis frequently experience pain and anxiety due to repeated arteriovenous fistula use. This study aimed to assess anxiety levels, pain severity during arteriovenous fistula cannulation, and associated factors in patients undergoing hemodialysis.

Materials and Methods: This study is a descriptive, cross-sectional study. One hundred and sixty-eight adults who met the inclusion criteria were recruited. Data were collected through face-to-face interviews. The Individual Identification Form, Visual Analog Scale, and State-Trait Anxiety Inventory were used in data collection. For data analysis, IBM SPSS Statistics (Version 24) was used, and p-values < 0.05 were considered statistically significant.

Results: Individuals experienced mild to moderate anxiety levels (state anxiety = 48.91 ± 9.76, trait anxiety = 48.22 ± 9.28) and reported pain due to arteriovenous fistula cannulation (4.32 ± 2.43). Factors such as age, duration of arteriovenous fistula, state and trait anxiety levels, presence of anxiety related to arteriovenous fistula, type of needle used, intake of anxiolytics, and the development of arteriovenous fistula-related complications were found to significantly influence arteriovenous fistula cannulation pain, explaining 46.4% of the variance (R^2 = 0.464).

Discussion: The study found that individuals undergoing hemodialysis experience mild to moderate levels of anxiety and pain. Accordingly, the assessment and management of anxiety and arteriovenous fistula-related pain symptoms, which are frequently observed and can trigger each other, are essential for enhancing satisfaction with hemodialysis treatment, improving treatment adherence, and reducing the risk of mortality.

Keywords

anxiety, arteriovenous fistula, hemodialysis, pain, symptom management

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Introduction

Hemodialysis (HD) is a widely used treatment modality for patients with end-stage renal disease, and the most commonly used type of vascular access is the arteriovenous fistula (AVF) [1]. Therefore, repeated cannulation leads to pain and anxiety in patients [1,2].

Previous studies indicate that individuals undergoing HD most commonly experience headaches, musculoskeletal pain, and discomfort related to cannulation, which have significant biopsychosocial effects [1,3-6]. Pain and anxiety associated with AVF use are frequently reported among this population [1,6-10]. The prevalence of pain related to AVF cannulation has been reported to range from 38.0% to 60.9%, while needle fear has been observed in 25% to 47% of patients [2,9,11-13].

The most common emotional responses experienced by individuals undergoing HD due to AVF cannulation are pain and anxiety [1,6,8]. Anxiety increases pain perception, while pain can also elevate anxiety levels [8].In addition, planned painful procedures have been reported to intensify anxiety and perceived pain [8,9].

The literature indicates that individuals experience varying levels of anxiety related to interventions performed during dialysis and the pain experienced [1,8,9,14,15]. It has been reported that 25% of individuals who experience needle-related pain and anxiety refuse HD treatment, while 15% are reluctant to use an AVF due to needle fear [13]. Additionally, pain persists after cannulation in 11.3% of individuals, which adversely affects the continuity of HD sessions [16].

These conditions increase mortality risk, highlighting the importance of managing anxiety and AVF-related pain [10]. This study aimed to assess anxiety levels and pain severity during AVF cannulation, as well as associated factors, in patients undergoing HD.

Research Questions

1. What are the levels of pain and anxiety experienced during AVF cannulation?
2. Is there an association between pain and anxiety during cannulation?
3. Which factors predict pain severity during AVF cannulation?

Materials and Methods

Design and Participants

The study was descriptive and cross-sectional. The study was conducted in two HD centers in Kayseri province between July 1 and September 31, 2019. In the centers, the periodic assessment of pain and anxiety during AVF cannulation is not performed. Local anesthetic creams are used prior to cannulation at the patient's request to reduce the sensation of pain. The inclusion and exclusion criteria for the study were established through a review of the literatüre [4,7]. The study included individuals aged ≥ 18 years who were able to communicate effectively and had been receiving HD via an AVF for at least three months. Individuals with infection at the fistula site, cognitive impairment, or prior use of local anesthetics before cannulation were excluded. The study population comprised 227 patients with AVF treated at the participating HD centers. The sample size was calculated using G*Power software; based on a two-tailed test with a 5% Type I error rate, 95% power, and an effect size of 0.3, a minimum of 134 participants was required. The study was completed with 168 volunteers who met the inclusion criteria and was reported in accordance with the STROBE guidelines.

Data Collection

Data were collected through face-to-face interviews using the Individual Identification Form developed based on the literature, the Visual Analog Scale, and the State–Trait Anxiety Inventory. A pilot study was conducted with five participants to assess the feasibility of the instruments and the duration of administration; these participants were not included in the main study. The Individual Identification Form consisted of 16 items and was used to obtain participants' sociodemographic and disease-related characteristics [3,4,7,10,17].

Pain intensity associated with AVF cannulation was assessed using the Visual Analog Scale, a 10-cm scale anchored at 0 (no pain) and 10 (severe pain), on which participants marked their perceived pain intensity. Higher scores indicate greater pain severity [18]. The validity and reliability of the VAS in Türkiye were established by Gür et al. [19].

Anxiety levels were assessed using the State–Trait Anxiety Inventory, developed by Spielberger et al. and adapted to Turkish by Öner and Le Compte. The inventory consists of two 20-item subscales measuring state anxiety (current feelings) and trait anxiety (general anxiety experienced over the previous seven days), rated on a 4-point Likert scale. Total scores for each subscale range from 20 to 80, with higher scores indicating greater anxiety [20]. In this study, Cronbach's alpha coefficients were 0.907 for the Trait Anxiety Inventory and 0.839 for the State Anxiety Inventory.

Data Analysis

Continuous variables were presented as mean±standard error, and categorical variables as frequencies and percentages. Group comparisons were performed using the independent samples t-test and one-way ANOVA, while associations between variables were examined using Pearson correlation analysis. Factors associated with pain during AVF cannulation were analyzed using multiple linear regression (enter method). All analyses were conducted using IBM SPSS Statistics version 24, and a $p < 0.05$ was considered statistically significant.

Ethical Approval

This study was approved by the Ethics Committee of Kayseri University (Date: 2019-06-21, No: 18/2019).

Results

Detailed data on the distribution of pain and anxiety levels during AVF cannulation according to demographic characteristics are provided in Supplementary Table S1. Among HD patients, the mean pain score was 4.32±2.43, the mean trait anxiety score was 48.22±9.28, and the mean state anxiety score was 48.91±9.76. Higher pain scores were observed in individuals who did not use analgesic or anxiolytic medications and in those reporting anxiety related to AVF ($p < 0.05$). Trait anxiety levels were significantly higher among women and illiterate individuals, while anxiety levels were significantly higher among housewives ($p < 0.05$).

Pain levels during AVF cannulation were significantly negatively associated with HD and AVF duration, and positively associated with pre-cannulation pain and anxiety scores ($p < 0.05$). AVF duration showed significant negative correlations with trait anxiety and pain levels, while state anxiety was negatively associated with HD duration and positively associated with pain during cannulation ($p < 0.05$; Table 1).

Scale score distributions according to AVF characteristics are presented in Table 2. Pain during cannulation was significantly associated with cannulation technique, needle type, and AVF-related complications, while anxiety scores differed by active fistula location ($p < 0.05$).

Table 3 presents the results of the multivariable linear regression analysis (enter method) examining factors associated with AVF cannulation pain. Age, AVF duration, state and trait anxiety, presence of fistula-related anxiety, needle type, anxiolytic use, and fistula-related complications were significantly associated with pain ($p < 0.05$). The model explained 46.4% of the variance in pain intensity ($R^2 = 0.464$). Higher pain levels were observed with increasing age, shorter fistula duration, presence of anxiety, use of standard needles, absence of anxiolytic use, development of complications, and higher state and trait anxiety scores.

Discussion

Pain and anxiety levels experienced during dialysis vary according to the interventions applied [1,6-9,14-15]. In this study, pain related to AVF cannulation (4.32 ± 2.43) and anxiety levels (state anxiety = 48.91 ± 9.76; trait anxiety = 48.22 ± 9.28) among HD patients were found to be mild to moderate. These findings are consistent with the literature, which predominantly reports mild to moderate pain severity during vascular access cannulation in HD patients [1,4,5,7,10,16-17]. Emotional responses associated with AVF cannulation include anxiety, fear, and helplessness [8]. Experimental studies have reported moderate to high pre-cannulation anxiety levels [3,4]. Factors such as needle gauge, cannulation technique, the nurse's experience and approach, as well as patients' perceptions, prior experiences, and motivation may influence pain and anxiety during cannulation. These factors can lead to variability both between individuals and within the same individual over time; therefore, assessments conducted at different time points in the same group may yield differing results.

In this study, increasing age was positively associated with greater pain severity during cannulation. However, several studies have reported no association between age and pain levels [5]. This discrepancy may be related to prior experiences and individual pain thresholds within the study population. No significant association was found between age and anxiety levels, consistent with some previous reports [9,15]. In contrast, a meta-analysis indicated that needle fear decreases with increasing age [21].

In this study, women exhibited higher pain and anxiety scores than men, with a significant increase particularly observed in trait anxiety levels. These findings are consistent with previous studies examining pain associated with AVF cannulation [17]. Additionally, housewives reported higher pain and anxiety levels; however, this difference was statistically significant only for anxiety, reflecting the influence of female gender. It is well established that anxiety levels are higher in women than in men both in the general population and among patients undergoing HD, which may explain the elevated trait anxiety observed in female participants in this study [15,21]. Conversely, some studies have reported no association between gender and cannulation fear, suggesting that anxiety experienced during cannulation may be multifactorial [19]. Similarly, Çelik and Acar (2007) reported higher anxiety scores in female HD patients, although the difference was not statistically significant [14]. Sociocultural roles, increased responsibilities, and hormonal factors may contribute to women experiencing greater pain and anxiety.

In this study, illiterate individuals exhibited higher pain and anxiety levels; however, only the increase in trait anxiety reached statistical significance. Conversely, some studies have found no association between educational level and pain or anxiety, which may be attributable to differences in sample size and the distribution of educational levels [5,15].

In this study, the use of systemic analgesics and anxiolytics was associated with lower pain and anxiety levels. Although some studies report that mild pain may persist despite analgesic use, the literature supports the effectiveness of pharmacological and supportive interventions in reducing pain and anxiety [3,4,9,10].

Pain related to vascular access cannulation and needle phobia are common among patients undergoing HD [2,7-9]. In this study, individuals reporting cannulation-related anxiety had higher pain and anxiety levels, and increased anxiety was associated with greater pain severity. These findings are consistent with previous evidence indicating a positive association between anxiety and pain [1,4].

In this study, shorter durations of AVF use and HD treatment were associated with higher pain and anxiety levels, with significant effects observed particularly for pain and trait anxiety. These findings are consistent with studies reporting increased pain and anxiety in patients with shorter dialysis duration and newly established fistulas [1]. However, other studies have found no association between treatment duration and pain or anxiety [5,7,15,17]. Such discrepancies may be related to patients' adaptation to treatment and the accumulation of experience over time.

In this study, cannulation performed using blunt-tipped needles and the buttonhole technique was associated with significantly lower pain severity, whereas needle type and cannulation technique did not affect anxiety levels. These findings are consistent with previous studies reporting reduced pain and anxiety with the use of blunt-tipped needles and the buttonhole technique [16,22].

In this study, the presence of AVF-related complications was not associated with anxiety levels but was related to pain severity. Individuals with aneurysm/pseudoaneurysm experienced lower pain severity during cannulation. The literature contains limited studies jointly examining cannulation-related pain and anxiety in patients with fistula complications. This finding suggests that structural skin changes associated with aneurysm/pseudoaneurysm may facilitate cannulation and reduce perceived pain [16,23].

In this study, individuals using a right brachial AVF exhibited lower pain and anxiety levels; however, only the difference in anxiety levels was statistically significant. These findings are consistent with studies reporting an association between fistula location and anxiety [1]. Evidence regarding the relationship between fistula location and pain remains inconsistent [1,7]. Such variability may be related to factors including the mobility of the brachial region, anatomical characteristics, and coexisting neuropathic conditions. The literature indicates that proximal AVF sites are associated with an increased risk of pain and

Table 1. Distribution of AVF Cannulation Pain (VAS) and State-Trait Anxiety Inventory (STAI) scores according to the numerical descriptive characteristics of individuals

Characteristics	Total n (%)	State anxiety scores (STAI-S)		Trait anxiety scores (STAI-T)		Pain Level During Cannulation (VAS)	p†
	Mean(SD)	r	p	r	p	r	p
Age	55.07(14.07)	.052	.505	.075	.335	R = .112	.148
HD Duration, months	86.33(69.16)	-.173*	.025	-.153*	.048	-.236**	.002
AVF Duration, months	65.81(56.8)	-.150	.053	-.162*	.035	-.307**	< .001
VAS-Pain Before Cannulation	0.37(1.1)	.071	.360	.065	.400	.375**	< .001
STAI-S	48.91(9.76)	1		.640**	< .001	.443**	< .001
STAI-T	48.22(9.28)	.640**	< .001	1		.424**	< .001
VAS-Pain During Cannulation	4.32(2.43)	.443**	< .001	.424**	< .001	1	

Abbreviations: HD = hemodialysis; AVF = arteriovenous fistula; STAI-S = state anxiety scores; STAI-T = trait anxiety scores; VAS = Visual Analogue Scale,† Pearson korelasyon analizi * < .05 ** < .001

that brachiobasilic fistulas are linked to more severe pain compared with other fistula types [16]. Variations across studies may be related to the mobility of the brachial region, anatomical characteristics of vascular access, and the presence of concomitant neuropathic conditions.

Limitations

This study has several limitations. Primarily, the levels of pain and anxiety were assessed based on subjective criteria. Behavioral assessments of pain, such as grimacing, were not conducted. Secondly, pain and anxiety may influence individuals' physiological and biological parameters (such as pulse, respiration, and cortisol levels). Thirdly, the sample size of the study is small, which limits the generalizability of the findings. Fourthly, factors that could influence pain and anxiety levels, such as individual differences, comorbidities, and variations among the nurses performing the cannulation, were not taken into account.

Conclusion

Arteriovenous fistula cannulation in individuals undergoing HD treatment is a continuous requirement. In this context, the experience of pain and anxiety may be an inevitable situation. In this study, individuals reported their pain and anxiety levels to be mild to moderate.

Table 2. Distribution of AVF Cannulation Pain (VAS) and State-Trait Anxiety Inventory (STAI) scores according to ındividuals' characteristics related to AVF

Characteristics of AVF	Total n (%)	State anxiety scores (STAI-S)		Trait anxiety scores (STAI-T)		Pain Level During Cannulation (VAS)	p
		Mean(SD)	p	Mean(SD)	p	Mean(SD)	
Cannulation Technique							
Buttonhole Technique	32(19.0)	49.68(7.26)		48.90(5.56)		3.25(0.38)	
Rope Ladder	82(48.8)	48.59(8.22)	.868**	47.59(7.33)	.698**	4.56(0.24)	.021**
Area Puncture	54(32.1)	48.92(12.86)		48.75(13.05)		4.60(0.37)	
Needle Type							
Standard	157(93.5)	49.03(10.01)	.524*	48.17(9.52)	.826*	4.53(2.35)	< .001*
Blunt	11(6.5)	47.09(4.90)		48.81(4.85)		1.40(1.46)	
AVF Complication							
Absent	139(82.7)	48.79(10.46)		47.82(9.77)		4.44(0.21)	
Aneurysm/Pseudoaneurysm	13(7.7)	47.84(5.88)	.773**	49.30(6.88)	.586**	2.53(0.51)	.047**
Dilation	14(8.3)	51.35(4.66)		50.35(5.73)		4.75(0.41)	
Hematoma-Bleeding	2(1.2)	47.0(1.41)		54.0(7.07)		4.70(0.80)	
Active AVF Region							
Right Radial AVF	10(6.0)	49.80(9.60)		49.90(6.48)		4.30(3.41)	
Left Radial AVF	98(58.3)	49.94(7.69)	.011**	49.16(6.61)	.041**	4.30(2.18)	.844**
Right Brachial AVF	13(7.7)	40.46(13.98)		41.53(10.96)		3.84(2.42)	
Left Brachial AVF	47(28.0)	48.89(11.45)		47.74(12.88)		4.52(2.74)	

Abbreviations: AVF = arteriovenous fistula; STAI-S = state anxiety scores; STAI-T = trait anxiety scores; VAS = Visual Analogue Scale, *Independent sample t test; ** One-way ANOVA

Table 3. Evaluation of factors explaining pain levels (VAS) during avf cannulation of ındividuals through multiple linear regression analysis (Enter Model)

Independent Variable	B	Stnd. Beta	t	p	95.0% CI	
					Lower Bound	Upper Bound
Age	.023	.131	2.226	.027	.003	.043
AVF Duration. months	-.005	-.124	-2.009	.046	-.011	.000
Anxiety Associated with AVF (Present)	.814	.133	2.Şub	.045	.018	Oca.61
Reference = [Absent]						
Needle Type (Standard)	2.687	.274	4.651	< .001	1.546	3.829
Reference = [Blunt]						
Anxiolytic Use (Absent)	Oca.67	.19	3.135	.002	.618	2.722
Reference = [Absent]						
Complication in AVF (Aneurysm/Pseudoaneurysm Present)	-1.792	-.197	-3.321	.001	-2.857	-.726
Reference = [Absent]						
STAI-S	.06	.241	3.098	.002	.022	.098
STAI-T	.049	.186	2.365	.019	.008	.09
(Constant)	-5.021		-4.383	< .001	-7.283	-2.759

Model: R = .681; R2 = 464; Adj. R2 = 437; F = 17.193; p < .001 Durbin-Watson = 2.018 Dependent Variable: Pain Level During Cannulation (VAS) Abbreviations: AVF = arteriovenous fistula; β = partial correlation coefficient; STAI-S = state anxiety scores; STAI-T = trait anxiety scores

Various factors influencing pain and anxiety were identified in this study, including age, gender, education level, use of analgesic and anxiolytic medications, duration of HD treatment, duration of AVF use, cannulation method, type of needle, AVF region, and the presence of aneurysms/pseudoaneurysms in the AVF. Ensuring patient satisfaction and enhancing quality of life and comfort are crucial aspects of healthcare. Therefore, it is important for healthcare professionals to assess pain and anxiety levels. Supporting patients and understanding their needs are essential to reduce pain and anxiety effectively. In this context, nurses can benefit patients by modifying the cannulation technique and the type of needle used. Additionally, uncovering individuals' emotions and thoughts related to pain and anxiety, as well as developing coping strategies, can be considered fundamental elements of care. The development of trust between nurses and patients, as well as therapeutic communication, can be effective in managing pain and anxiety. Evidence-based pharmacological and non-pharmacological interventions may be recommended to reduce pain and pain-related anxiety. However, there is a need for more randomized controlled trials in this area.

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The authors declare that they are responsible for the article's scientific content, including study design, data collection, analysis and interpretation, writing, and some of the main line, or all of the preparation and scientific review of the contents, and approval of the final version of the article.

Animal and Human Rights Statement
All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Data Availability Statement
The datasets used and/or analyzed during the current study are not publicly available due to patient privacy reasons but are available from the corresponding author on reasonable request.

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The authors declare that there is no conflict of interest.

Ethics Declarations
This study was approved by the Ethics Committee of Kayseri University (Date: 2019-06-21, No: 18/2019)

Effectiveness of combination tramadol and tenoxicam versus transdermal fentanyl patches in post-laparotomy

Eurasian Clinical and Analytical Medicine Original Research

Analgesic effects of tramadol and tenoxicam

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Abstract

Aim: This study aimed to compare postoperative pain management protocols and to identify the regimen that minimizes morphine consumption in patients receiving a transdermal fentanyl (TDF) patch, with or without adjunctive tramadol and/or tenoxicam.

Materials and Methods: Eighty patients were enrolled in this randomized study. All patients received a TDF patch (50 μg / h) applied 12 hours before surgery, and patient-controlled analgesia with morphine was initiated in the post-anesthetic care unit. Patients were divided into four groups (n = 20 each): Group 1 received no additional analgesia; Group 2 received tramadol 100 mg four times daily; Group 3 received tenoxicam 20 mg once daily; and Group 4 received both tramadol (100 mg four times) and tenoxicam (20 mg once). Demographic data, hemodynamic parameters, Ramsay Sedation Scale (RSS), resting and mobilization visual analog scale (VAS) scores, respiratory rate, oxygen saturation, side effects, and morphine consumption were recorded over 24 hours.

Results: Morphine consumption differed significantly between groups at each 6-hour interval, with Groups 1 and 4 showing significantly different consumption compared with the other groups ($p < 0.05$). Resting VAS scores were lower in Group 1 compared with Group 4 at the 2nd and 4th hours ($p < 0.05$). Oxygen saturation values were significantly lower in Group 1 at the 1st and 2nd postoperative hours compared with Groups 2 and 4 ($p < 0.05$). Combined tramadol and tenoxicam administration resulted in lower pain scores at multiple time points.

Discussion: Tramadol or tenoxicam alone provided comparable postoperative analgesia, whereas their combined use resulted in more effective pain control without increasing complication rates.

Keywords

postoperative pain control, tramadol, tenoxicam, transdermal fentanyl patch

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Introduction

Today, patient-controlled analgesia (PCA) prepared with opioids is widely used in postoperative pain control, but side effects such as nausea-vomiting, dizziness, respiratory depression, hypotension and urinary retention may occur [1].

According to the World Health Organization (WHO), the combination of paracetamol or opioid and NSAID is considered the second step, depending on increasing pain severity [2]. Pain mechanism have different pathways. Therefore, it may be difficult to provide effective analgesia with a single drug. With the combination of different groups of analgesic drugs, more effective analgesia and fewer side effects can be achieved at lower doses by targeting both central and peripheral pathways. Various pain management guidelines for postoperative analgesia have been developed in the last 20 years, but drug combination studies are still needed [3,4].

Intravenous patient-controlled analgesia (PCA) stands out as the recently preferred method in systemic application. Opioids (tramadol, morphine, fentanyl, alfentanil, meperidine, sufentanil), nonsteroidal anti-inflammatory agents (tenoxicam, ketorolac, ibuprofen, acetaminophen, diclofenac) and ketamine are used in systemic administration [3,4]. Tramadol is a racemic compound consisting of two isomers with both opioid and non-opioid activity. Tramadol is now widely used in postoperative pain control because it shows monoaminergic activity. Tramadol is a synthetic opioid that acts through two separate synergistic mechanisms of action. It causes weak μ-opioid receptor activation and reuptake inhibition as a monoamine neurotransmitter in the pain inhibition pathway, such as norepinephrine-serotonin. Tramadol does not usually cause cardiovascular or respiratory depression [5,6].

Tenoxicam belongs to the NSAID group. NSAIDs are popular and widely used in postoperative pain control because they do not cause respiratory depression [7,8].

In our study, we aimed to compare the effectiveness of using tramadol and/or tenoxicam with the application of a transdermal fentanyl patch after laparotomy on postoperative pain control.

Materials and Methods

This prospective randomized study included 80 patients, aged between 18 and 65, who were evaluated as I-II-III according to the American Society of Anesthesiologists (ASA) classification in the pre-anesthesia evaluation and would undergo laparotomy surgery. Patients with kidney and liver failure, patients with cardiac problems, patients with a history of allergy to opioids and the drugs to be administered, pregnant women, patients with opioid addiction, patients with chronic lung disease, patients with dermatological disorders, patients weighing less than 50 kg and over 100 kg. Patients with psychiatric disorders were excluded from the study.

The patients included in the study were evaluated preoperatively, one day before the operation, and randomly divided into 4 groups after obtaining written and verbal consent forms. Group 1 (TDF, n = 20) which preoperative transdermal fentanyl patch was applied, Group 2 (TDF + Tramadol, n = 20) which was applied preoperative TDF and postoperative tramadol 100 mg 4 x 1, Group 3 (TDF + Tenoxicam, n = 20) which was applied preoperative TDF and postoperative tenoxicam 20 mg and Group 4 (TDF + Tramadol + Tenoxicam, n = 20), which preoperative TDF was applied and postoperative tramadol 100 mg 4 x 1 and tenoxicam 20 mg were applied. Postoperatively, all patients were planned to be fitted with a PCA device (Group 1: TDF + PCA; Group 2: TDF + 4 X 100 mg Tramadol + PCA; Group 3: TDF + 20 mg Tenoxicam + PCA; Group 4: TDF + 4 X 100 mg Tramadol + 20 mg Tenoxicam + PCA).

Before applying preoperative TDF tape to all patients, systolic arterial pressure (SAP), diastolic arterial pressure (DAP), mean arterial pressure (MAP), heart rate (HR), respiratory rate (RR), resting-mobilized visual analog scale (VAS), Ramsey sedation score (RSS) and peripheral oxygen saturation (SpO2) values were recorded. Then, 50 μg / h was administered to all patients on the anterior chest wall or arm 12 hours before the operation. Fentanyl (Durogesic 50 μg / h 5TTS Patch, Johnson & Johnson, Istanbul, Turkey) patch was applied, and the patients' symptoms and findings of nausea, vomiting, bradycardia, dyspnea, diarrhea/constipation and itching were recorded until the operation. No medication was given to the patients for premedication in the preoperative preparation room. The PCA device, which will be installed in the postoperative recovery room, was introduced to all patients, and its use was explained in detail.

The patients underwent electrocardiography (ECG), systolic arterial pressure (SAP), diastolic arterial pressure (DAP), mean arterial pressure (MAP), heart rate (HR) and peripheral oxygen saturation (SpO2) monitoring in standard DII lead. Hemodynamic measurements, sedation scores and VAS values of all patients were recorded in the operating room before induction. The sedation scores of the patients were evaluated with RSS. After preoxygenation (at 10 L / min for 1 min) in the operating room, anesthesia induction (2 mg / kg propofol (Fresenius Kabi, Istanbul, Turkey), 1 μ / kg fentanyl (Tadilat, 0.5 mg, 10 ml, Vem İlaç, Istanbul, Turkey), and 0.6 mg / kg intravenous rocuronium) was administered. The patient was intubated 3 minutes after the muscle relaxant was given. For anesthesia maintenance, 1.5-2% sevoflurane (Sevorane, Abott, Istanbul, Turkey) in 50% O2 + 50% N2O was applied.

As a muscle relaxant maintenance dose, 0.01 mg / kg rocuronium bromide was used when necessary. At the end of the operation, sevoflurane was discontinued, and its muscle relaxant effect was antagonized with atropine (0.01-0.02 mg / kg) and neostigmine (Neostigmine, 0.5 mg / ml, Adeka İlaç, Samsun, Istanbul) (0.04-0.08 mg / kg). When it was determined that their spontaneous breathing was sufficient, the cases were extubated by aspirating oropharyngeal secretions. No postoperative additional medication was given to Group 1, tramadol (Ultramex 100 mg 2 ml, Adeka İlaç, Samsun, Turkey) 100 mg iv was administered to Group 2 and postoperative 3 x 1 tramadol iv was ordered, Group 3 was given tenoxicam (Tenoxicam 20 mg lyophilized vial, Mustafa Nevzat İlaç San. A.Ş., Istanbul, Turkey) was given 20 mg iv, Group 4 was given tramadol 100 mg and tenoxicam 20 mg iv and postoperative 3 x 1 tramadol iv was ordered.

Side effects, resting-mobilized VAS level, nausea-vomiting, diarrhea-constipation, itching and amounts of morphine consumed were recorded at 1, 2, 4, 6, 12 and 24 hours postoperatively. Transdermal fentanyl and PCA device were removed at the 24th postoperative hour. Those whose SpO2 was below 90% within 24 hours, whose heart rate was 50 or less despite the administration of atropine, and whose respiratory rate was 8 or less per minute, had their fentanyl patches and PCA devices removed and were excluded from the study. If necessary, naloxone (Naloxone HCL, 0.4 mg / ml), Abbott Laboratories, Istanbul, Turkey, was planned to be given and antagonized, but it was no longer necessary.

Statistical Analysis

SPSS for Windows version 22.0 package program was used for statistical analysis, and $p < 0.05$ was considered statistically significant. For comparison of numerical measurements in more than two independent groups, ANOVA and LSD tests were used for variables with normal distribution, and Kruskal-Wallis and Dunn tests were used for variables without normal distribution. Relationships between verbal variables were tested with the chi-square test. Repeated measures analysis of variance was applied to test the changes in repeated measurements over time. In power analysis, the minimum sample size required in each group was determined to be 17 in order to find a significant change of

2 ± 2 units in the amount of morphine consumption in the TDF-TRMDL group at the 2nd hour compared to the TDF-OKS group ($\alpha = 0.05$, $1 - \beta = 0.80$).

Ethical Approval

This study was approved by the Ethics Committee of Gaziantep University, Faculty of Medicine (Date: 2014-04-21, No: 152).

Results

83 patients were included in the study. Three patients were excluded from the study because hypotension developed. All 80 patients completed the study. Demographic data are shown in Table 1. When these data were examined statistically, there was no significant difference between the groups ($p > 0.05$).

There was no significant difference between the groups in postoperative measurements of hemodynamic parameters SAB, DAB, MAP and HR ($p > 0.05$). Postoperative respiratory rates of the patients were significantly higher in Group TDF-OKS at all hours than in Group TDF-TRMDL at the 2nd, 4th, 6th, 12th, and 24th hours ($p < 0.05$). However, Group TDF-OKS was significantly higher than Group TDF-TRMDL-OKS at the 6th and 24th hours ($p < 0.05$). Group TDF-TRMDL-OKS was significantly higher than Group TDF-TRMDL at the 2nd and 12th hours and compared to Group TDF at the 12th hour ($p < 0.05$) (Table 2).

Postoperative saturation values of the patients were significantly lower in Group TDF at the 1st and 2nd hours than in Group TDF-TRMDL and Group TDF-TRMDL-OKS. At the 4th hour, it was significantly lower in Group TDF-OKS than in Group TDF-TRMDL and Group TDF-TRMDL-OKS ($p < 0.05$) (Table 3).

There was a significant difference between Group TDF and the other 3 groups, and between Group TDF-TRMDL-OKS and the other 3 groups, in the postoperative morphine consumption of the patients at every 6 hours of follow-up ($p < 0.05$). Morphine consumption was higher in Group TDF and lower in Group TDF-TRMDL-OKS.

Postoperative resting VAS values of the patients were significantly lower in Group TDF than in Group TDF-TRMDL-OKS at the 2nd and 4th hours ($p < 0.05$).

All patients were on the 1st, 2nd, 4th, 6th, 12th and 24th postoperative

Table 1. Comparison of groups according to demographic data

		Group 1 (TDF) (n = 20)	Group 2 (TDF-TRMDL) (n = 20)	Group 3 TDF-OKS (n = 20)	Group 4 TDF-TRMDL-OKS (n = 20)	P value
Age (years) (Mean ± SD)		49.85 ± 9.48	52.25 ± 14.50	53.20 ± 12.90	52.85 ± 13.55	0.839
BMI (Mean ± SD)		27.15 ± 4.60	28.75 ± 3.36	28.12 ± 3.64	27.10 ± 4.87	0.533
Operation Time (hours) (Mean ± SD)		2.45 ± 0.68	2.90 ± 0.55	3.05 ± 0.88	2.90 ± 0.78	0.068
Gender n (%)	Female	5(25%)	10(50%)	11(55%)	9(45%)	0.239
	Male	15(75%)	10(50%)	9(45%)	11(55%)	
Operation Type n (%)	Cancer	7(35%)	3(15%)	5(25%)	6(30%)	0.288
	Hepatobiliary	5(25%)	9(45%)	6(30%)	2(10%)	
	Ileus	8(40%)	8(40%)	9(45%)	12(60%)	
ASA n (%)	I	3(15%)	2(10%)	3(15%)	2(10%)	0.965
	II	9(45%)	10(50%)	7(35%)	10(50%)	
	III	8(40%)	8(40%)	10(50%)	8(40%)	

Table 2. Comparison of groups according to postoperative respiratory rate values

	Group 1 (TDF) Mean ± SD	Group 2 (TDF-TRMDL) Mean ± SD	Group 3 TDF-OKS Mean ± SD	Group 4 TDF-TRMDL-OKS Mean ± SD	P value
1st hour	19.55 ± 1.14	18.70 ± 1.78†	20.25 ± 1.71	19.70 ± 2.02	0.043*
2nd hour	18.10 ± 1.16†	17.65 ± 1.13†‡	19.60 ± 0.09	18.75 ± 2.42	0.001*
4th hour	17.45 ± 1.14†	17.55 ± 1.60†	19.35 ± 1.34	18.45 ± 2.43	0.002*
6th hour	16.85 ± 0.98†	16.95 ± 1.27†	19.35 ± 1.34‡	17.90 ± 3.09	0.001*
12th hour	16.85 ± 0.98†‡	16.95 ± 1.46†‡	19.25 ± 1.61	18.20 ± 2.35	0.001*
24th hour	16.60 ± 1.63†	16.95 ± 1.50†	19.40 ± 2.13	17.75 ± 2.24†	0.001*

* $p < 0.05$; † $p < 0.05$ vs TDF-OKS; ‡ $p < 0.05$ vs TDF-TRMDL-OKS

Table 3. Comparison of groups according to postoperative SPO2 values

	Group 1 (TDF) Mean ± SD	Group 2 (TDF-TRMDL) Mean ± SD	Group 3 TDF-OKS Mean ± SD	Group 4 TDF-TRMDL-OKS Mean ± SD	P value
1st hour	94.25 ± 2.42	95.60 ± 0.753‡	95.15 ± 2.20	96.25 ± 1.40‡	0.008*
2nd hour	94.95 ± 2.11	96.25 ± 1.29‡	95.30 ± 1.71	96.30 ± 1.30‡	0.021*
4th hour	95.70 ± 0.92	96.55 ± 1.39†	95.25 ± 1.44	96.30 ± 1.55†	0.014*
6th hour	95.90 ± 0.55	96.50 ± 1.39	95.60 ± 1.42	96.25 ± 1.01	0.063
12th hour	96.30 ± 0.57	96.45 ± 1.05	95.80 ± 1.32	96.55 ± 1.09	0.118
24th hour	96.55 ± 0.68	96.20 ± 1.05	95.75 ± 1.33	96.45 ± 1.23	0.109

* $p < 0.05$; † $p < 0.05$ vs TDF-OKS; ‡ $p < 0.05$ vs TDF

days. Clinical findings of nausea, vomiting, itching, and diarrhea-constipation were recorded. The statistical result obtained by the chi-square test was insignificant ($p > 0.05$).

Discussion

Postoperative respiratory rates were clinically higher at certain time points in the TDF-OKS and TDF-TRMDL-OKS groups compared with the other groups. Similarly, postoperative oxygen saturation levels were clinically lower at some hours in the TDF and TDF-OKS groups. A significant difference in postoperative morphine consumption was observed between the TDF group and the other three groups, as well as between the TDF-TRMDL-OKS group and the remaining groups, at each 6-hour interval. Morphine consumption was highest in the TDF group and lowest in the TDF-TRMDL-OKS group. Resting VAS scores were significantly lower in the TDF group than in the TDF-OKS group at the 2nd and 4th postoperative hours.

Many methods have been described for postoperative pain management. These include patient-controlled analgesia (intravenous and epidural), transcutaneous electrical nerve stimulation, and continuous spinal or epidural analgesia as current approaches. But these systems also increase costs [9]. Today, opioid-prepared PCA is widely used in postoperative analgesia. However, side effects such as nausea, vomiting, dizziness, hypotension, respiratory depression and urinary retention may occur [10]. For this reason, in our study, the second-step treatment method (tramadol and/or tenoxicam), which is a combination of paracetamol or opioid and NSAID, was used as mentioned in the WHO analgesia treatment pattern ladder.

In the study by Mimic et al., intravenous tramadol was used for preemptive analgesia in patients undergoing ureteroscopic lithotripsy for unilateral ureteral stones. Patients were randomized to receive either 100 mg tramadol in 500 mL 0.9% NaCl or saline alone preoperatively. VAS scores and the need for rescue diclofenac were recorded. Although first-hour postoperative VAS scores were significantly lower in the tramadol group, no difference was observed at later time points. Tramadol was considered safe due to the absence of respiratory or cardiac depression [11]. In our study, tramadol was preferred for its safety profile. Based on the limited duration of effect reported by Mimic et al., tramadol was administered every 6 hours postoperatively. Morphine consumption was significantly higher in the TDF group than in the TDF-TRMDL group at all postoperative time points, while no significant differences were observed in VAS scores, complication rates, hemodynamic variables, or respiratory parameters. These findings further support the efficacy and safety of tramadol in postoperative pain management without increasing adverse effects.

Choi et al. compared fentanyl-based PCA with intravenous tramadol for postoperative analgesia in patients undergoing laparoscopic surgery for colorectal cancer. In this study, including 261 patients, one group received fentanyl-PCA, while the other received IV tramadol on demand based on VAS scores, with ketorolac added if necessary. Postoperative hospital stay was significantly longer, and anesthesia-related costs were higher in the PCA group. The authors concluded that fentanyl-PCA was not essential for effective postoperative analgesia, as comparable pain control could be achieved with IV tramadol, with fewer side effects and lower costs [12]. In our study, tramadol and/or tenoxicam were administered in combination with a transdermal fentanyl patch to reduce the need for IV morphine PCA in laparotomy patients. Morphine consumption was significantly lower at all postoperative time points in the adjunct treatment groups compared with the TDF-only group, thereby minimizing PCA-related disadvantages.

Sathitkarnmanee et al. evaluated the efficacy of a transdermal fentanyl (TDF) patch for postoperative analgesia in patients undergoing total knee arthroplasty. In this randomized study of 40 patients, a 50 μg / h TDF patch was applied 12 hours preoperatively in one group, while the control group received a placebo patch; all patients were managed with morphine PCA for 48 hours. The authors demonstrated that preoperative TDF significantly reduced postoperative pain scores and morphine consumption without increasing adverse effects [13]. In our study, morphine consumption via PCA was used as the primary objective indicator of analgesic efficacy. To minimize opioid-related complications, a 50 μg / h TDF patch was applied preoperatively in all groups. Consistent with the findings of Sathitkarnmanee et al., this approach contributed to reduced overall morphine requirements and may have mitigated opioid-related respiratory and cardiovascular side effects.

Visual Analog Scale (VAS) scoring has become a safe method due to its ease of use, validity and reliability in defining the severity and intensity of pain. A VAS score below 4 is an acceptable analgesic level [14-16]. In a study conducted by Russo et al., patients who underwent laparotomy were compared with IVHKA prepared with morphine and ketorolac for postoperative analgesia control with patients administered IV morphine HKA and IV ketorolac. As a result of the study, VAS values were lower at all hours, and side effects such as analgesic requirement and nausea and vomiting were less in the Ketoralac IV push group compared to the infusion group. It was concluded that intravenous administration of ketorolac at regular intervals (8 hours apart) provides more effective analgesia than continuous infusion. Ketorolac is an NSAID commonly used for postoperative pain control. The advantages of NSAIDs in pain control after laparotomy have been reported in many studies [17-19]. We also used VAS as a pain scoring system in our study. In our study, since the average VAS value in all groups and hours except Group TDF-TRMDL-OKS 1st hour was 4 and below, we can say that we provided effective analgesia for 24 hours postoperatively in all four groups.

Chandanwale et al. compared the efficacy and safety of tramadol–paracetamol and tramadol–diclofenac combinations in postoperative pain, acute osteoarthritic exacerbations, rheumatoid arthritis, and acute musculoskeletal disorders. In this randomized study of 204 patients, the tramadol–diclofenac combination provided superior analgesia with fewer side effects, indicating that diclofenac was a more appropriate NSAID than paracetamol in these settings [20]. In our study, tenoxicam was preferred instead of paracetamol in combination with tramadol as a second-step analgesic strategy. The combined use of tramadol and tenoxicam achieved comparable analgesia with significantly lower morphine consumption in the TDF-TRMDL-OKS group compared with groups receiving tramadol or tenoxicam alone, without an increase in complication rates.

Ural et al. compared oral, intramuscular, and transdermal diclofenac sodium for postoperative analgesia in patients undergoing laparoscopic cholecystectomy. VAS scores were significantly lower in the intramuscular and transdermal groups compared with the oral group at all time points, and tramadol consumption was also reduced in these groups. The authors concluded that transdermal diclofenac provided analgesic efficacy comparable to intramuscular administration and superior to oral use [21]. In our study, intravenous tenoxicam was preferred as the NSAID component of postoperative analgesia.

Das et al. compared the efficacy and safety of lornoxicam and tramadol for postoperative analgesia following head and neck surgery and demonstrated that lornoxicam was as effective and safe as tramadol [22]. In our study, tenoxicam–another oxicam-derived NSAID–was used, and no significant differences were observed between the TDF-TRMDL and TDF-OKS groups in terms of mean VAS scores at any time point, total morphine consumption, or side effect rates.

Su et al. investigated the effect of flurbiprofen on postoperative pain control after thymectomy in patients with myasthenia gravis and demonstrated that flurbiprofen was effective and safe for post-thymectomy analgesia [23]. In our study, no statistically significant difference was observed in mean morphine consumption between tenoxicam and tramadol at any postoperative time point. However, unlike the findings of Su et al., morphine consumption tended to be lower in the tramadol group, while complication rates were comparable between groups.

Shankariah et al. compared ketorolac and tramadol for postoperative analgesia following maxillofacial surgery and reported that intramuscular tramadol provided superior analgesic efficacy [24]. In our study, no significant difference was found in side effect rates between tramadol and tenoxicam. In contrast to Shankariah et al., analgesic efficacy assessed by morphine consumption did not differ significantly between tramadol and tenoxicam.

Limitations

Our study has some limitations. The limited number of patients in our study, short follow-up period, generalizability of study findings and the nonhomogeneous injury patterns can be considered among the limitations of our study.

Conclusion

Since the effectiveness and complications of many drugs and methods used for postoperative pain control vary, appropriate drug combination studies continue to be controversial. There was no change in the hemodynamic parameters in the postoperative analgesia control of the use of tramadol and/or tenoxicam, accompanied by TDF patch application. The use of tramadol and tenoxicam alone provided equal analgesia, while their use together provided more effective analgesia and did not change the complication rate. The combination of tramadol and/or tenoxicam, accompanied by TDF patch application, can be used safely in postoperative pain management control.

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Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content, including study design, data collection, analysis and interpretation, writing, and some of the main line, or all of the preparation and scientific review of the contents, and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Data Availability Statement

The datasets used and/or analyzed during the current study are not publicly available due to patient privacy reasons but are available from the corresponding author on reasonable request.

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Conflict of Interest

The authors declare that there is no conflict of interest.

Ethics Declarations

This study was approved by the Ethics Committee of Gaziantep University, Faculty of Medicine (Date: 2014-04-21, No: 152)

Prognostic factors on renal survival in idiopathic nephrotic syndrome

Eurasian Clinical and Analytical Medicine Original Research

Renal survival in idiopathic nephrotic syndrome

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Abstract

Aim: Idiopathic nephrotic syndrome is the most common primary glomerular disease in children. The optimal therapeutic regimen for managing children at the onset and during idiopathic nephrotic syndrome is still under debate.

Materials and Methods: A 10-year retrospective review of 185 children with idiopathic nephrotic syndrome at the University hospital identified 125 eligible patients. At the last follow-up, they were classified as steroid-dependent, steroid-resistant, or in remission.

Results: Steroid-resistant nephrotic syndrome was observed in 27 patients (21.6%) and steroid-dependent nephrotic syndrome in 34 patients (27.2%). Male predominance (M/F: 1.9) was consistent with the literature. Only 9 patients (7.2%) had no relapse after the first episode, while 64 patients remained in remission at the last follow-up. Sixty patients (48%) received at least one immunosuppressive agent other than steroids. Frequent relapses and steroid resistance were significantly more common in patients with obesity at diagnosis. Low albumin level at diagnosis, time to first remission, immunosuppressive drug use, pulse steroid requirement, hypertension, and macroscopic hematuria were significant prognostic factors for renal survival in patients in remission. The prognostic albumin cut-off value was 1.8 g / dL.

Discussion: Although it is hard to withdraw robust conclusions from our results, it might be thought that children with obesity, hypoalbuminemia (< 1.8 g / dL), and female gender seem to deserve closer follow-up and somewhat more aggressive management in idiopathic nephrotic syndrome in terms of renal survival.

Keywords

steroid resistance nephrotic syndrome, steroid-dependent nephrotic syndrome, prognosis

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Introduction

Idiopathic nephrotic syndrome (INS) is the most common primary glomerular disease in children [1]. A minority of children with the condition have only a single episode (20-33%), with the remaining having, in order of increasing severity, infrequent relapses, frequent relapses, steroid dependence, or steroid resistance [2]. The prognosis of children with INS mainly depends on the underlying histopathology and can be predicted by the response to steroid treatment [3]. The optimal therapeutic regimen for managing children at onset and during INS is still under debate [4]. The number of prospective or long-term studies on the subject is quite small. We retrospectively evaluated the demographic and prognostic features of 185 patients with idiopathic nephrotic syndrome in our clinic.

Materials and Methods

A retrospective chart review of 185 children with idiopathic nephrotic syndrome followed for 10 years in the Kocaeli University Faculty of Medicine Department of Pediatric Nephrology was done. Demographics, laboratory data, and prognostic factors were retrieved from the patients' hospital records. Prenatal and natal histories and consanguinity of parents were noted. Preterm delivery was defined as births before the 38th week of gestation. All laboratory and clinical parameters that may affect prognosis were recorded. The reviewed data were age at presentation, gender, follow-up period, preterm delivery, oligohidramniosis, obesity, family history of kidney disease, hematuria, complement 3 (C3) level, albumin level at presentation, hypertension, acute kidney injury at onset, chronic kidney disease, first time in remission, pulse steroid and steroid sparing treatment, the longest remission time, renal biopsy and remission status at last visit. Predisease body weights were taken as the basis to determine the relationship between obesity and prognosis to exclude the impact of edema as a confounder at the time of diagnosis. After data collection, 60 patients who did not come to follow-up visits regularly or those with missing data were excluded from the study. Patients diagnosed with congenital nephritic syndrome and secondary nephritic syndrome were excluded from the study. The remaining 125 idiopathic nephrotic syndrome patients were included in the study. According to their status at last follow-up, patients were grouped as steroid dependent, steroid resistant, and in remission.

Treatment Protocol

All patients initially were treated with prednisone (60 mg / m2 / day) for a full duration of 30 days, while relapses were treated with oral prednisone at 60 mg / m2 / day until remission plus 3 additional days. Then the prednisone dose was tapered to 40 mg / m2 every other day for 4 weeks, followed by a reduction of 10 mg / m2 every other day per week to the lowest dose required to maintain remission and ultimately, discontinuation of treatment if appropriate. Steroid-sparing agents were introduced if the patient presented with frequent relapses or steroid resistance.

Statistical Analysis

All statistical analyses were performed using IBM SPSS for Windows version 22.0. Kolmogorov- Smirnov tests were used to test the normality of data distribution. Continuous variables were expressed as mean ± standard deviation, median (25th-75th percentiles), and categorical variables were expressed as counts (percentages). The relationship between numerical variables was evaluated by Spearman Correlation Analysis. Receiver operating curve (ROC) analysis was performed to determine the cutoff value, sensitivity, and specificity of different cutoff points for albumin, first time in remission. The most appropriate cutoff point was chosen according to ROC analysis, and the area under the curve (AUC) was calculated. Survival analysis according to albumin level and first remission time was performed with the Kaplan-Meier method. Two-tailed $P < 0.05$ was considered statistically significant.

Ethical Approval

This study has been approved by the Ethics Committee of Kocaeli University, Faculty of Medicine (Date: 2019-01-04, No: 52).

Results

A total of 125 patients were included in the study with INS. Male / female ratio was 1.9 (82 / 43). While there was no significant difference between boys and girls for steroid-resistant nephrotic syndrome (SRNS), it was found that girls had a significantly increased risk for steroid-dependent nephrotic syndrome (SDNS) development and frequent relapses ($p < 0.05$).

The median age of diagnosis was 48 months (12-192 months), and the mean follow-up period was 50 months (20-204 months). 11 patients (8.8%) had a history of premature birth (38 gestation weeks), and 29 patients (23.2%) had a family history of kidney disease. 12 patients (9.6%) had macroscopic hematuria, 9 patients (7.2%) had acute kidney injury, 8 of 12 patients with macroscopic hematuria developed SRNS ($p < 0.001$), but no significant difference was found in the development of SDNS. 31 patients (24.8%) required pulse steroid treatment at the time of diagnosis, and the risk of developing SRNS was significantly higher in these patients ($p < 0.001$). 23 patients (18.4%) had stage 2 hypertension at the time of diagnosis; the risk of developing SRNS was significantly higher in these patients ($p < 0.001$). 60 patients (48%) had used at least one additional immunosuppressive drug other than a steroid. The most common side effects of cyclosporine were hirsutism and gingival

Table 1. Longest remission time compared to immunosuppressive agents

Drug	Number of patients (%)	The longest remission time
Cylosporin A	60 (%48)	15 (1-108)
Levamisole	31 (%24.8)	8 (1-84)
Cyclophosphamide	38 (%30.4)	6 (1-48)
Mycophenolate	29 (%23.2)	3 (1-19)
Tacrolimus	4 (%3.2)	13 (1-15)

Table 2. Clinical data and outcome of 125 children with idiopathic nephrotic syndrome

	SRNS	SDNS	Remission
N	27 (%21.6)	34 (%27.2)	64 (%51.2)
Age at onset (months)	89 (36-150)	44 (31-60)	48 (36-68)
Follow-up (months)	84 (36-132)	72 (36-112)	36 (24-84)
Male / female ratio	2	0.7	2
First time in remission (months)	1	1	3
Methylprednisolone pulse (N)	24	6	7
Use of steroid sparing	24	30	30
therapy (N)			
Cylosprorin A (N)	20	23	17
Levamisole (N)	3	16	12
Mycophenolate (N)	14	9	6
Cyclophosphamide (N)	21	6	11
Tacrolimus (N)	1	-	1
Chronic kidney disease	8	2	-

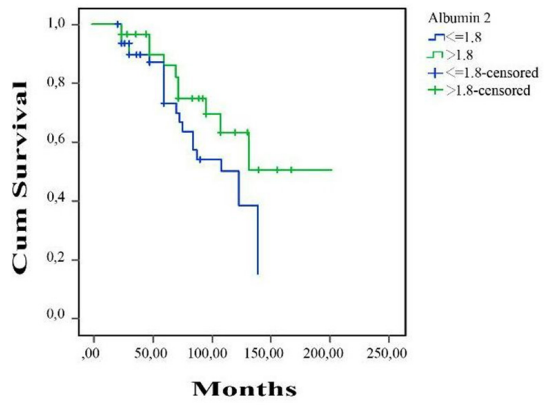

Figure 1. Affect of abumin level on renal survival

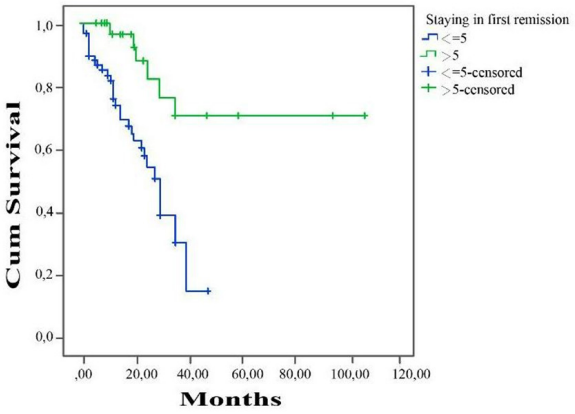

Figure 2. First remission time and renal survival

hypertrophy. These side effects improved with the discontinuation of the drug. Biopsy-proven nephrotoxicity developed in one patient out of 44 patients using cyclosporine (1.6%). Clinical details of each immunosuppressive drug are given in Table 1.

SRNS in 27 patients (21.6%), SDNS in 34 patients (27.2%), and chronic kidney disease (CKD) in 10 patients (8%) developed (Table 2).

The number of patients who did not relapse after the first episode was only 9 (7.2%). 64 patients were still in remission at the last clinic visit. Eight of 10 patients who developed CKD needed a pulse at the time of diagnosis, and 4 of 10 had macroscopic hematuria ($p < 0.05$). Of the 4 patients with end- stage renal failure, 1 patient was transplanted, and 3 patients are still undergoing hemodialysis. The histopathological findings of 66 patients who underwent kidney biopsy were as follows: 14 focal segmental glomerulosclerosis (FSGS) (11.2%), 23 mesangioprolipherative glomerulonephritis (MesPGN) (18.4%), 29 minimal change disease (MDH) (23.2%). The baseline body weight of 64 patients (51.2%) was above the 90th percentile ($p < 0.05$). No significant relationship was found between obesity and SDNS, but the rate of frequent relapses and SRNS was significantly higher in patients with obesity at the time of diagnosis ($p < 0.05$). Two patients died (1.6%) because of cardiovascular complications.

In our study, albumin level at diagnosis, first remission time, immunosuppressive drug use, pulse steroid requirement, accompanying hypertension, and macroscopic hematuria at diagnosis were found to be significant prognostic factors for renal survival in patients who were followed up in remission. The critical albumin level affecting prognosis was found to be 1.8 g / dL (cut-off point = 1.8 g / dL, AUC: 0.82, confidence interval (CI): 95%, 0.629 to 0.805, sensitivity = 85.00, specificity = 75.50, $p < 0.05$). Five-year renal survival was found to be 67% in patients with albumin level < 1.8 g / dL at time of diagnosis, and 89% in patients with albumin > 1.8 g / dL (Figure 1). Similarly, at the end of 5 years follow-up, remission rate of the patients achieving to stay in first remission shorter than 5 months was significantly lower than those who sustained their first remmision longer than 5 months (cut-off point = 5 months, AUC: 0.90 confidence interval (CI): 95% 0.70 to 0.81, sensitivity = 89.00, specificity = 51.50, $p < 0.05$) (Figure 2).

Discussion

Although idiopathic nephrotic syndrome is predominantly steroid-sensitive, the clinical importance and disease burden mostly stem from the development of frequent relapses, steroid dependence, or resistance [4,5]. The lack of a clear consensus on the treatment of patients with SRNS and SDNS further complicates the situation. Steroids are the basis of the treatment, but the development of steroid dependence makes the management of INS difficult. Because of chronic steroid exposure, these children are at risk of serious complications necessitating steroid-sparing drugs as alternative therapy [2]. The high risk of progression to chronic kidney disease in SRNS is another concern for these patients. So far, several prognostic factors for SRNS and SDNS development have been described in various studies [3,5].

In our study, we retrospectively examined clinical and laboratory parameters that may be effective on the prognosis of children with INS. Our results, in general, were in parallel with the literature. However, to the best of our knowledge, we encountered some parameters that were not previously reported. There was no correlation between age at presentation and future relapses among our patients, similar to the findings of Fujinaga et al [6]. On the other hand, some studies found a significant correlation between age at presentation and an increased risk of frequent relapses [7,8]. Again, male predominance (M / F: 1.9) in our study was inconsistent with the literature. While there was no significant difference between gender and the risk for SRNS development, we found that significantly more girls developed SDNS and frequent relapses than boys ($p < 0.05$). This result was contrary to the literature [7,9].

Macroscopic hematuria was highlighted by several studies, some of which said that the presence of hematuria was independently associated with late steroid resistance [8,10,11]. Similarly, 8 out of 12 patients with macroscopic hematuria developed SRNS ($p < 0.001$). Another finding in agreement with the literature was the development of more SRNS in patients with hypertension at the time of diagnosis. Additionally, 31 patients (24.8%) required pulse steroid treatment at the time of diagnosis, and 60 patients (48%) required steroid-sparing drug; the risk of developing SRNS was significantly higher in these patients ($p < 0.001$). In many studies, the risk of SDNS development was reported to be high in patients with a first remission time of < 9 days [3,5]. Due to missing data in hospital records of the patients, we could not make this analysis. But as for the relationship between the duration of staying in first remission and prognosis, patients staying in first remission.

There are a few studies investigating the relationship between obesity and prognosis. Current studies have shown that the incidence of ESRD in FSGS is higher in obese patients due to glomerulomegaly [12,13]. Since there was an average edema-induced weight increase of 1.5 kilograms at the time of diagnosis, the latest known predisease healthy body weights were used for comparison. And in 64 patients it was > 75 percentile ($p < 0.05$). No significant relationship was found between obesity and SDNS development, but the rate of frequent relapse and SRNS was significantly higher in obese patients compared to normal weight patients ($p < 0.05$). To the best of our knowledge, this relation is reported for the first time in the literature. Given the limited number of published cases of obesity related SRNS and SDNS and that a significant number of them derive from autopsy studies, little is known

about the outcome of these patients. Information about the clinical features that may distinguish these cases from INS is also scarce [12]. Further research with larger number of patients are needed to be able to know for sure whether obesity is a true prognostic factor for SDNS or SRNS in INS. However, several studies have demonstrated that obese patients show characteristic haemodynamic changes of glomerular hyperfiltration, including vasodilation of glomerular afferent arterioles with increased glomerular filtration rates and increased filtration fraction [14,15]. The characteristic insulin resistance and hyperinsulinaemia of obese patients could play a fundamental role in the pathogenesis of these haemodynamic changes [14,16]. In addition, insulin can increase the synthesis of several growth factors that induce glomerular sclerosis and hypertrophy [17]. In obese patients, the increased incidence of glomerulomegaly might be the factor facilitating proteinuria. However, edema is not apparent in obese patients despite nephrotic proteinuria. The reasons why obese patients with nephrotic proteinuria do not develop oedema are unknown. Some studies reported that patients with massive proteinuria but without hypoalbuminaemia, as in obese patients, as observed in hyperfiltering disorders, have significantly lower urinary excretions of N-acetyl-B-glucosaminidase and β2-microglobulin than patients with hypoalbuminaemia [12]. These differences may suggest an altered tubular handling of filtered proteins in hyperfiltering disorders. In addition, the slow increase in proteinuria, characteristic of FSGS, may play an important role in the absence of hypoalbuminaemia and oedema, allowing compensatory mechanisms to counterbalance proteinuria [18].

With advancing technology, many novel markers that are thought to be effective at the molecular level of INS pathogenesis emerge in the literature, and their probable effects on the prognosis of INS are investigated. However, these tests are not widely available, and their cost is quite high, like soluble urokinase plasminogen activator receptor (suPAR). Thus, easily available and cheaper alternatives like albumin are investigated in order to be used as a prognostic marker [19]. In such studies, hypoalbuminemia has been shown to trigger thromboembolic events [20]. In another study, low albumin level was associated with frequent relapses [21,22]. In our study, we detected a statistically significant cutoff albumin level affecting the prognosis of 1.8 g / dL ($p < 0.05$). Five-year renal survival of the patients with albumin levels below this cutoff value was significantly lower than those above the cutoff (67% vs 89%) ($p < 0.05$). Similarly, patients with albumin < 1.8 g / dL had a significantly increased risk for SRNS and SDNS development compared to others ($p < 0.05$). This albumin cutoff might be clinically used as a prognostic factor in children with INS, but the need for confirmation by other studies is obvious.

At the end of the follow-up period, the number of patients who did not relapse after the first episode was 9 (7.2%), which is relatively low compared to the literature [1]. This can be explained by the fact that mostly the complicated patients who frequently relapse or who are refractory to treatment are referred to our center.

The retrospective nature and some missing data in patient records are the weak points of our study. But, a relatively large sample size and a considerably long follow-up period might still render our results clinically usable in predicting the outcome of children with INS.

Limitations

Among the limitations of the study are its retrospective nature and the resulting lack of some patient data. More advanced results could have been obtained with a prospective study involving a larger number of participants.

Conclusion

Although it is hard to withdraw robust conclusions from our results, it might be thought that children with obesity, hypoalbuminemia (< 1.8 g / dL), and female gender seem to deserve closer follow-up and somewhat more aggressive management in INS in terms of renal survival.

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Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content, including study design, data collection, analysis and interpretation, writing, and some of the main line, or all of the preparation and scientific review of the contents, and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Data Availability Statement
The datasets used and/or analyzed during the current study are not publicly available due to patient privacy reasons but are available from the corresponding author on reasonable request.

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Conflict of Interest
The authors declare that there is no conflict of interest.

Ethics Declarations
This study was approved by the Ethics Committee of Kocaeli University, Faculty of Medicine (Date: 2019-01-04, No: 52)

Interventional radiology: current applications, clinical impact, and future directions

Eurasian Clinical and Analytical Medicine Review

Interventional radiology

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Abstract

Interventional radiology (IR) is a rapidly evolving medical specialty that utilizes image-guided, minimally invasive techniques for diagnostic and therapeutic purposes. By offering practical alternatives to conventional surgical procedures, IR significantly reduces patient morbidity, shortens hospital stay, and improves recovery times. Advances in imaging technology, materials science, and procedural techniques have expanded the scope of interventional radiology across vascular, non-vascular, and oncologic applications. This review provides a comprehensive overview of the historical development, fundamental principles, major clinical applications, safety considerations, and future perspectives of interventional radiology.

Keywords

interventional radiology, minimally invasive therapy, embolization, ablation, image-guided interventions

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Introduction

Interventional radiology is a subspecialty of radiology that focuses on performing minimally invasive procedures under imaging guidance. Since its inception in the 1960s, interventional radiology has transformed patient management by providing effective diagnostic and therapeutic alternatives to open surgery. The pioneering work of Charles T. Dotter, who introduced percutaneous transluminal angioplasty, is widely regarded as the foundation of modern interventional radiology [1].

The integration of imaging modalities such as fluoroscopy, ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI) has enabled precise targeting of pathological lesions. As a result, interventional radiology has become an essential component of multidisciplinary clinical practice, particularly in vascular disease, oncology, trauma, and palliative care [2].

Fundamental Principles of Interventional Radiology

Interventional radiology is based on three core principles:

- Image guidance: Procedures are performed using real-time imaging to ensure accuracy and safety.
- Minimally invasive access: Most interventions are carried out through small skin incisions or percutaneous needle punctures.
- Targeted therapy: Treatments are directed specifically at the pathological site, minimizing damage to surrounding tissues.

These principles contribute to reduced complication rates, lower healthcare costs, and improved patient satisfaction compared to conventional surgical approaches [3].

Vascular Interventional Radiology

Diagnostic angiography

Diagnostic angiography remains a cornerstone of vascular assessment. It provides high-resolution visualization of arterial and venous anatomy and is essential for evaluating peripheral arterial disease, aneurysms, vascular malformations, and tumor vascularity [4].

Angioplasty and stent placement

Percutaneous transluminal angioplasty (PTA), with or without stent placement, is widely used to treat vascular stenoses and occlusions. Common indications include lower extremity arterial disease, carotid artery stenosis, renal artery stenosis, and central venous obstruction. These techniques have demonstrated outcomes comparable to surgical revascularization, with lower procedural risk and faster recovery [5].

Embolization techniques

Embolization involves the intentional occlusion of blood vessels to control bleeding or devascularize pathological tissue. Indications include gastrointestinal hemorrhage, postpartum hemorrhage, traumatic bleeding, and tumor management. A variety of embolic agents—such as coils, particles, liquid embolics, and plugs—are selected based on clinical requirements [6].

Non-Vascular Interventional Radiology

Image-guided biopsy

Image-guided percutaneous biopsy is a highly accurate and safe method for tissue diagnosis. Ultrasound- and CT-guided biopsies are routinely used for lesions in the lung, liver, kidney, bone, and soft tissues. Compared to surgical biopsy, these techniques offer lower complication rates and reduced procedural costs [7].

Percutaneous drainage procedures

Percutaneous drainage of abscesses, fluid collections, and biliary obstructions is a fundamental non-vascular application of interventional radiology. These procedures often serve as definitive treatment or as a bridge to surgery, particularly in critically ill or high-risk patients [8].

Gastrointestinal and genitourinary interventions

Procedures such as percutaneous gastrostomy, nephrostomy, and biliary drainage play a critical role in managing obstruction, infection, and nutritional compromise. These interventions significantly improve patient quality of life and reduce morbidity [9].

Interventional Oncology

Interventional oncology represents one of the fastest-growing domains within interventional radiology.

Tumor ablation techniques

Thermal ablation techniques—including radiofrequency ablation (RFA), microwave ablation (MWA), and cryoablation—are increasingly used for the treatment of primary and metastatic tumors of the liver, kidney, lung, and bone. These techniques are particularly valuable for patients who are poor surgical candidates [10].

Transarterial therapies

Transarterial chemoembolization (TACE) and transarterial radioembolization (TARE) are established treatments for hepatocellular carcinoma and selected metastatic liver tumors. These methods combine targeted drug or radiation delivery with embolization to achieve tumor control while preserving healthy liver parenchyma [11].

Complications and Safety Considerations

Although interventional radiology procedures are generally safe, potential complications include bleeding, infection, vascular injury, and contrast-related adverse reactions. Proper patient selection, meticulous technique, and post-procedural monitoring are essential to minimize risks [12].

Radiation safety is a critical concern in interventional practice. Adherence to the "as low as reasonably achievable" (ALARA) principle is essential to protect both patients and healthcare personnel from unnecessary radiation exposure [13].

Training and Multidisciplinary Collaboration

Interventional radiologists undergo extensive training that includes diagnostic radiology, procedural skills, and clinical patient management. Multidisciplinary collaboration with surgeons, oncologists, and other specialists enhances treatment planning and optimizes patient outcomes [14].

Future Directions

Technological advancements such as artificial intelligence–assisted image guidance, robotic interventions, and advanced navigation systems are expected to further expand the capabilities of interventional radiology. These innovations promise increased precision, reduced complications, and more personalized treatment strategies [15].

Conclusion

Interventional radiology has become an indispensable component of modern healthcare. Its minimally invasive, image-guided techniques offer safe and effective alternatives to traditional surgical approaches across a wide range of clinical scenarios. Ongoing technological and educational advancements will continue to enhance the role of interventional radiology in patient-centered care.

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Scientific Responsibility Statement
The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and Human Rights Statement
All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or compareable ethical standards.

Data Availability Statement
The datasets used and/or analyzed during the current study are not publicly available due to patient privacy reasons but are available from the corresponding author on reasonable request.

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The authors declare that there is no conflict of interest.

Comment on: clinical value of circulating tumor DNA for patients with epithelial ovarian cancer

Eurasian Clinical and Analytical Medicine *Letters to Editor*

Circulating tumor DNA

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Abstract

The purpose of this letter is to highlight the potential clinical effects and importance of circulating tumor cells and circulating tumor DNA (ctDNA) in oncology patients undergoing PRP (Platelet-Rich Plasma) therapy. ctDNA and circulating tumor cells are considered important biomarkers of disease progression and minimal residual disease in solid tumors. With the increasing use of PRP and exosome-based therapies in cosmetic and regenerative medicine in recent years, the theoretical risk of contamination with tumor material from current or past malignancies, despite these biological products being derived from the patient's own blood, has been raised. The long-term oncological safety of these applications is not yet clear. On the other hand, the potential role of ctDNA and PRP-derived components in cancer surveillance and personalized oncology treatments is being investigated. Until sufficient long-term evidence is available, it would be appropriate to avoid such biological and cosmetic interventions in patients with a history of cancer or to prefer individualized treatment plans.

Letter to the Editor

The purpose of this letter is to highlight the potential clinical implications and importance of circulating tumor cells and DNA in oncology patients undergoing PRP (Platelet-Rich Plasma). The presence of circulating tumor DNA (ctDNA) and tumor cells can be a marker of disease progression and minimal residual disease in solid tumors, similar to hematological malignancies [1].

In recent years, the use of PRP and exosome-based therapies in cosmetic and regenerative medicine has increased. While these products are derived from patients' own blood and subjected to centrifugation and purification, the theoretical risk of contamination with tumor-derived material from existing or past malignancies remains [2]. Some studies have shown that these biologics may not have adverse effects in the short term; however, the long-term oncological safety of such treatments remains uncertain and requires further evaluation [3].

Additionally, many researchers are considering the potential role of circulating tumor DNA and PRP-derived components in cancer treatment monitoring and personalized oncology therapy [4]. However, until sufficient long-term evidence is available, it would be prudent to avoid such biologic/cosmetic interventions or plan individualized treatment for patients with a history of cancer.

Ethical Approval

This study did not require ethical approval according to the relevant guidelines.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content, including study design, data collection, analysis and interpretation, writing, and some of the main line, or all of the preparation and scientific review of the contents, and approval of the final version of the article.

Animal and Human Rights Statement

No animal or human studies were carried out by the authors for this article.

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Conflicts of Interest

None.

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